

## 1. ENGINEERING DATA

### 1.1 Engineering Summary

Jamison 1 is located in the Northern Territory Exploration Permit 18 (EP18) approximately 40km east-southeast of Dunmarra (Figure 1, PetNTow 4381). The well was designed as a stratigraphic test to identify the type and nature of the stratigraphy in a large gravity low, inferred to be a depression and informally termed the Beetaloo Sub-basin. The well proved the existence of the sub-basin. Jamison 1 was drilled by Pacific Oil & Gas Pty Limited as operator on behalf of the EP18 Joint Venture, using Rockdril Contractors Pty Limited's Rig 20, a Longyear 600.

Access to the location was via the Stuart Highway, 10km south from Dunmarra, then east via existing station roads and fence lines on Heyfield Station for 28km, then due east along a purpose built access track for 12km. Drill site preparation involved the clearing of a drilling pad over an area of approximately 150m x 150m and the digging of several pits. Drilling and potable water were obtained from a bore drilled on site which struck water at 110m in the Tindall Limestone.

Well site supervision was provided by Kevin Lanigan and John Torkington.

Drilling operations commenced at 1500hrs on October 16, 1990 with the drilling of a 12 $\frac{1}{2}$ -inch hole to 9.8m below the drilling floor. A 9 5/8-inch conductor was then set at 9.8m and cemented to surface with 15 sacks of Class A cement. Drilling operations were then suspended while the camp was rigged up. Operations recommenced with the drilling of a 8 $\frac{1}{2}$ -inch hole at 0945hrs on October 17, 1990 using compressed air and a down-hole hammer. The hole was drilled to a depth of 67.99m where a five barrel cement plug was spotted in order to stabilize the hole. The hole was then continued to 162.99m but no returns were observed from 110m. A wiper trip was conducted and BPB rigged up to run wireline logs. The Spontaneous Potential log was run in the hole which was found to be packed off at 110m with a standing water level at 105m. The SP was rigged down but a Gamma Ray and Caliper log was run from 110m to surface. BPB were rigged down and another wiper trip conducted prior to running casing.

Thirteen joints of 7-inch, 23-pound per foot, 8-round casing were run and the casing shoe landed at 156.37m below the drilling floor. The string was cemented with 10 barrels of cement (15.6 ppg slurry with 1% CFR-3). No cement returns were observed at surface. An additional 10 barrels of cement (15.3 ppg neat) were pumped down the annulus.

The BOP stack was nipped up and the hole continued to 189.53m using a 6 $\frac{1}{2}$ -inch down-hole hammer. At this point hammer drilling was prevented by a strong influx of water. A LCM (lost circulation material) pill was placed against this zone while waiting for rotary drilling equipment to be mobilized from Alice Springs. The LCM was successful in restricting the water influx, but only allowed the hammer to re-drill to 186.53m. A 6 $\frac{1}{2}$ -inch rotary drill string was made up and circulation established with a Rapid-gel mud system, with which the hole was drilled from 189.53 to 410.36m with (at times) severe circulation losses. After conditioning the hole 44 joints of K55, 131b, 5-inch casing were run and set at 409.10m with 19 barrels, of 15.6 ppg Class A cement (with 0.5% CFR-3). The BOP rams, choke manifold, HCR, kill and floor valves were tested to 2000 psi and the annular preventer to 1500 psi.

A 4½-inch rotary bit was made up and the float collar, casing shoe and cement drilled to 410.2m. The rotary drilling assembly was pulled from the hole and CHD 101 coring assembly made up and run in the hole. The mud system was also changed over to a Newdrill polymer mud system. Two metres of new formation were drilled and a formation integrity test conducted. The formation was found to leak off at 600 psi with 8.4 ppg mud in the hole. This equates to a mud weight equivalent of 17-pound per gallon. The hole was then continuously cored to 812.75m, at which point shows were observed in the core. The hole was conditioned and the drill-string strapped out of the hole prior to running a Drill Stem Test (DST).

DST-1 was made up and the lower Chambers River Formation tested over the interval 804.8 to 818.8m below the drilling floor (bdf) (Appendix 11a). The test was conducted as a closed chamber test with a 15-minute preflow, a 60-minute shut-in, a 250-minute flow period and a 1199-minute final shut-in. The closed chamber was blown down after the initial flow and again after the main flow period, and was found to contain flammable gas. The drill-string was pulled, and a small volume of mud recovered above the shut-in tool.

The CHD 101 drilling assembly was again made up and the hole continuously cored from 818.75m to 894.5m during which good shows were again observed in the core. The hole was conditioned, the drill string strapped out of the hole and DST-2 made up to test the interval 866-895m (bdf) in the upper part of the Bukalorkmi Sandstone (Appendix 11b). The test was conducted using a closed chamber and consisted of a 15-minute preflow, a 60-minute shut-in, and 173-minute main flow period. The flow period was terminated when leaking gas was observed in the annulus. The final shut-in was for a period of 960 minutes. The closed chamber was blown down after the initial flow and again after the main flow period, and was found to contain flammable gas. The drill-string was pulled and found to contain 100.4 metres of slightly gas-cut mud and formation water.

The CHD 101 core assembly was made up and the hole continuously cored from 894.95 to 930.45m at which point the drill-string was strapped out in order to conduct DST-3 (Appendix 11c). The test was conducted using a closed chamber over the interval 866-930.5m (bdf) in the Bukalorkmi Sandstone. The tool was opened for a 14-minute preflow, closed for a 60-minute shut-in, opened for a 449-minute flow period and shut-in for 1484 minutes. The closed chamber was blown down following both flow periods and was found to contain flammable gas. The drill-string was pulled and found to contain an estimated 1.5-2.0m of oil (most was lost during pulling of the test string) and 447.5m of mud-cut saline formation water.

A cement plug was then placed over the interval 930.45m to 904.6m in an attempt to isolate a perceived water-producing zone below 905m. DST-4 (Appendix 11d) was then made up and run in the hole to test the zone 889.3m to 904.6m (bdf). The test was conducted using a closed chamber for an initial 360-minute preflow followed by a shut-in of 809 minutes. The closed chamber was then blown down prior to an open chamber 1647-minute flow period. No hydrocarbons were detected at the surface and no build up was conducted following the extended flow. The drill-string was pulled, with a skim of oil found at the top of 676.5m of mud, mud filtrate and saline formation water.

The CHD 101 wireline coring assembly was made up and the hole continuously cored from 930.45m to 1766.85m, which was reached at 1200 hrs on December 20, 1990. The hole was then conditioned and a full suite of wireline logs run. Following this Velocity Data conducted a vertical seismic profile in the well.

The well was abandoned by placing a 12 $\frac{1}{2}$ -barrel cement plug over the interval 940-770, a 4-barrel cement plug over the interval 440-360m and a 45m cement plug at the surface. Rockdril's Rig 20 was released at 1800hrs on December 23, 1991. A chronological log of drilling activities is included as Appendix 1a and a time summary as Appendix 1b, with a graphical presentation given in the Drilling Progress Chart (Figure 2, PetN/Tcw 4396).

## 1.2 General Data

Well Name: Jamison 1

Well Type: Stratigraphic Test

Operator: Pacific Oil & Gas Pty Limited

Licence Holders: Pacific Oil & Gas Pty Limited 90%  
Pardi Pty Limited\* 10%  
(NB: \*Non-contributory Interest)

Petroleum Title: EP18, Northern Territory

Location: Approximately 40km east-southeast of Dunmarra  
Zone 53  
AGM E 368 483  
N 8 144 766  
Latitude: 16° 46' 34.7" South  
Longitude 133° 45' 57.5" East  
1:100 000 Sheet: Warramban 5664  
1:250 000 Sheet: Tanumbirini SE 53-2  
Seismic Line: SH90-103 VP 430  
MA91-98 VP 1615 + 10m  
MA91-103 VP 4817 + 12m

Elevation: Ground Level: 261m AHD  
Drilling Floor: 263.4m AHD

Total Depth: 1766.85m (Driller)  
1769m (Logger)

Commencement Date: October 16, 1990

Total Depth Reached: December 20, 1991

Rig Released: December 23, 1991

Drilled by: Rockdril Contractors Pty Limited  
Rig 20, Longyear 600

Datum: Drilling Floor: 263.4m AHD

Hole Size: 12½ inch to 9.8m  
8½ inch to 162.99m  
6½ inch to 410.36m  
110mm to 1766.85m

Wireline Logs: Spontaneous Potential 1769 -- 400m  
Dual Resistivity 1769 -- 400m  
Gamma Ray 1767 -- Surface  
Bulk Density 1767 -- 400m  
Neutron Porosity 1767 -- 400m  
Sonic 1769 -- 400m

Velocity Survey: A 19 shot, 16 level velocity survey was recorded.

Vertical Seismic Profile: A 39 level survey was recorded and a vertical seismic profile produced.

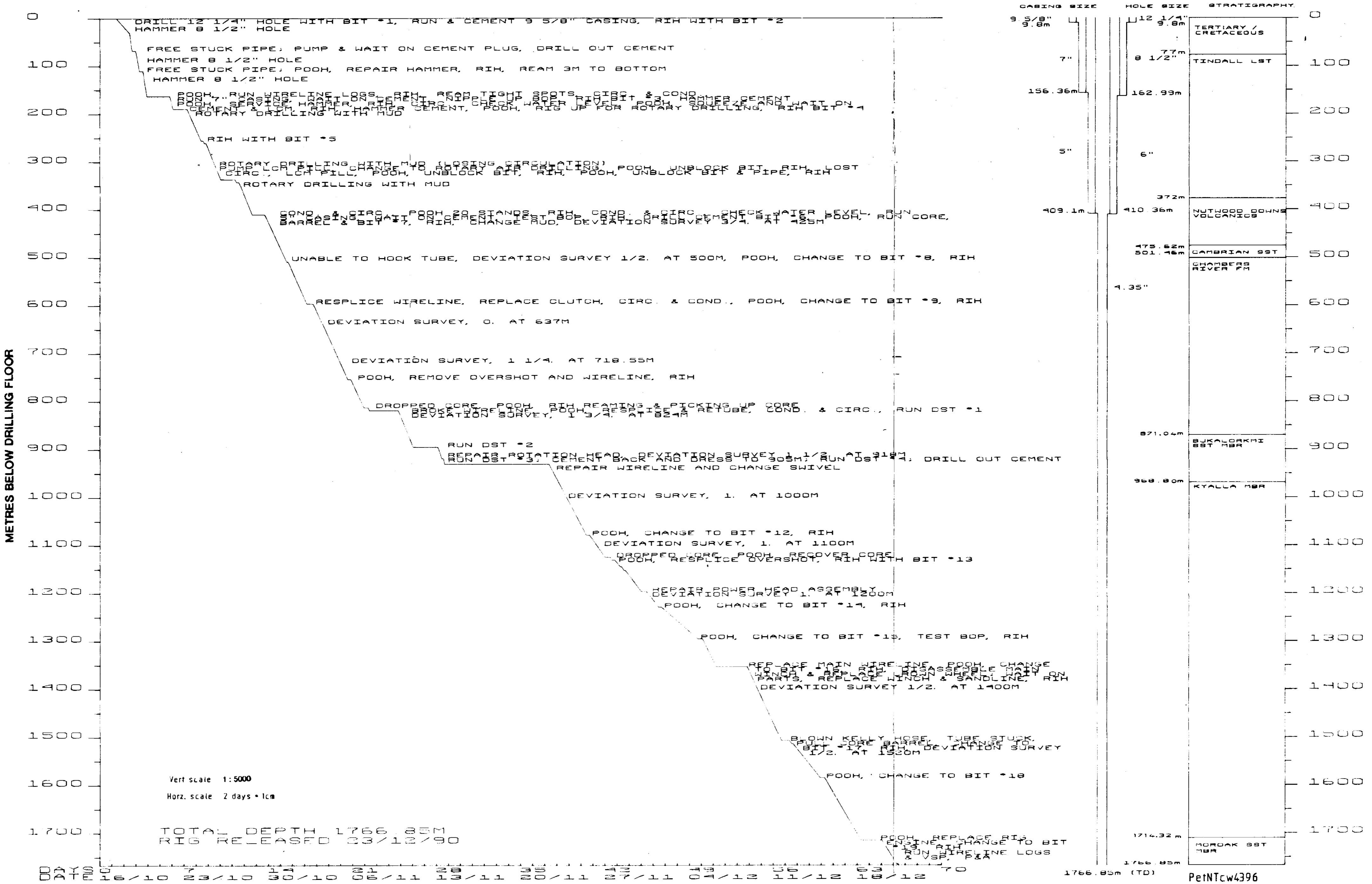
### 1.3 Drilling Rig

Rockdril Contractors Rig 20, a Longyear 600, was used to drill Jamison 1. Specifications for this rig and all associated plant are given in Appendix 2.

### 1.4 Hole Size and Depths

Drilling at Jamison 1 commenced with the rotary drilling of a 12½-inch conductor to 9.8 metres below the drilling floor, and 8½-inch hole was then drilled using a hammer and stiff foam to 162.99m. Following this a 6½-inch hole was drilled to 410.36m using a combination of hammer drilling with foam and rotary drilling with a gel-based mud system. The 5-inch casing shoe was drilled out with a 4½-inch rotary bit, following which the hole was continuously cored to 1766.85m using a CHD 101 slimhole coring assembly, fitted with a 110mm near-bit reamer.

# JAMISON-1 DRILLING PROGRESS CHART



Vert scale 1:5000  
 Horz. scale 2 days = 1cm

TOTAL DEPTH 1766.85M  
 RIG RELEASED 23/12/90

Total Depth Reached: December 20, 1991

Rig Released: December 23, 1991

Drilled by: Rockdril Contractors Pty Limited  
Rig 20, Longyear 600

Datum: Drilling Floor: 263.4m AHD

Hole Size: 12 $\frac{1}{2}$  inch to 9.8m  
8 $\frac{1}{2}$  inch to 162.99m  
6 $\frac{1}{2}$  inch to 410.36m  
110mm to 1766.85m

Wireline Logs: Spontaneous Potential 1769 - 400m  
Dual Resistivity 1769 - 400m  
Gamma Ray 1767 - Surface  
Bulk Density 1767 - 400m  
Neutron Porosity 1767 - 400m  
Sonic 1769 - 400m

Velocity Survey: A 19 shot, 16 level velocity survey was recorded.

Vertical Seismic Profile: A 39 level survey was recorded and a vertical seismic profile produced.

### 1.3 Drilling Rig

Rockdril Contractors Rig 20, a Longyear 600, was used to drill Jamison 1. Specifications for this rig and all associated plant are given in Appendix 2.

### 1.4 Hole Size and Depths

Drilling at Jamison 1 commenced with the rotary drilling of a 12 $\frac{1}{2}$ -inch conductor to 9.8 metres below the drilling floor, and 8 $\frac{1}{2}$ -inch hole was then drilled using a hammer and stiff foam to 162.99m. Following this a 6 $\frac{1}{2}$ -inch hole was drilled to 410.36m using a combination of hammer drilling with foam and rotary drilling with a gel-based mud system. The 5-inch casing shoe was drilled out with a 4 $\frac{1}{2}$ -inch rotary bit, following which the hole was continuously cored to 1766.85m using a CHD 101 slimhole coring assembly, fitted with a 110mm near-bit reamer.

## 1.5 Casing

Table 1 lists the various casing types used in Jamison 1.

Depth Set	Casing Set	Joint	Weight	Grade	Cement
9.8m	9 5/8 inch				
156.37m	7 inch	FL 45	23 ppf	K55	Class "A"
409.10m	5 inch	FL 45	13 ppf	K55	Class "A"

## 1.6 Drilling Mud

The Jamison 1 stratigraphic well was spudded using air as the drilling medium. Varying amounts of foam and stiff foam were progressively added until 189.53m, where a large water influx necessitated a conversion to rotary mud drilling. A Rapid-gel/native clay mud was used to drill from 189.53m to 410.36m, with partial to total loss of circulation. Various types of lost circulation material were added during the drilling of the 6 $\frac{1}{2}$ -inch hole in an attempt to reduce the degree of mud loss, however none were very successful.

Following the setting of the 5-inch casing, the Rapid-gel mud was used to drill out the cement and casing shoe. The mud system was then changed over to a Newdrill polymer system with the addition of small amounts of potassium chloride (KCl) to assist in shale inhibition. Typical mud properties were:- weight <9.0 ppg, viscosity 40-45 seconds, PV 16, YP 8, Gels 1/1, water loss <10cc, pH 9.0. Solids content of the mud was maintained as low as possible by replacing solids-contaminated mud with fresh pre-mix.

## 1.7 Water Supply

Drilling and potable water for use in the camp were both obtained from a waterbore drilled on-site. The bore produced at rates in excess of 40,000 litres per hour from cavities in the Tindall Limestone. Standing water level in the bore was 97m. The water was fresh, but quite hard.

## 1.8 Bit and Deviation Record

### 1.8.1 Drilling Bits

Appendix 3 contains details of all bits used in drilling Jamison 1.

### 1.8.2 Deviation

No deviation surveys were conducted in either the 8 $\frac{1}{2}$ -inch hole or the 6 $\frac{1}{2}$ -inch hole. Deviation surveys were taken approximately every 100m while drilling the 110mm hole from 410.2m to total depth. Results of all deviation surveys are given in Table 2.

Depth (m)	Deviation (degrees)
425	0.75
500	0.5
637	0
718.55	1.75
824	1.75
918	1.5
1000	1.0
1100	1.0
1200	1.0
1300	1.0
1400	0.5
1520	0.5
1600	0.5
1700	0.5

### 1.9 Cement Squeezes

Previous experience in drilling seismic upholes in the Beetaloo Sub-Basin has shown the presence of an unconsolidated sand directly overlying the Tindall Limestone. The sand can be held back while circulating, but tends to flow in behind the drill bit if circulation is lost. In an attempt to stabilize this sand a cement plug was placed in the bottom of the hole at 67.99m. While it was not possible to squeeze the cement into the formation, the plug was successful in stabilizing the sand and enabling the hole to be continued.

While drilling the Tindall Limestone at 189.53m a strong water-flow prevented the continuation of percussion drilling with air. While waiting on a rotary drill string to be mobilized from Alice Springs a cement squeeze was attempted over the interval 163.18m to 186.53m. This squeeze was found to have little effect in restricting the water influx.

Following DST-3 an attempt was made to isolate to lower 30 metres of the hole from 930.45m to 900m, which was interpreted at the time to be water saturated. The first attempt to set this plug was unsuccessful, however the second attempt (where the excess was reverse-circulated out of the hole) was successful, with the top of the plug being dressed off at 904.6m.



### 1.10 Formation Testing

Four bottom-hole drill stem tests (DST's) were conducted in Jamison 1 in response to hydrocarbon indications in a sand towards the base of the Chambers River Formation and in the upper part of the Bukalorkmi Sandstone. The first three tests were conducted in a conventional manner with a closed chamber, however DST-4 was run as an extended flow test with no final pressure build up. An interpretation of each of the DST's is included as Appendix 11, and a brief summary of each given below. (Note: data limitations and the complex nature of reservoir units intersected prevent the accurate definition of nett pays for each of the test intervals).

DST-1 was conducted to test a hydrocarbon indication intersected in a sand at the base of the Chambers River Formation. The test interval, 804.8-818.8m, flowed a small volume of hydrocarbon gas into the test string. The test indicated the sandstone to be slightly overpressured when compared to a water pressure gradient. This is thought to be due to the sand being completely encapsulated by mudstone.

DST-2 was conducted over the interval 866-895m, in the upper portion of the Bukalorkmi Sandstone. The test recovered filtrate, formation water and minor amounts of hydrocarbon gas into the test string. Minor problems were experienced throughout the final flow period, with gas escaping from the drill-string into the annulus at a well-head pressure of about 330 psi.

Following the recovery of gas in DST-2 it was decided to drill ahead to the base of the hydrocarbon shows. DST-3 was then conducted over the interval 871m to 930.5m and recovered a small amount of hydrocarbon gas, several gallons of oil, filtrate and highly saline formation water. Pressure data indicates the drill string was most likely leaking during this test. (Most of the oil was spilled onto the drill floor during the pulling of the drill pipe at the end of the test).

An attempt was then made to isolate an interpreted oil-saturated zone by placing a cement plug in the lower 30 metres of the hole. DST-4 was then run as an extended-flow test over the interval 889.3m to 904.6m, and recovered predominantly highly-saline formation water with a scum of oil.

Oil and water analysis for each drill stem test are included in Appendix 11.

### 1.11 Fishing and Related Operations

At 1112.95m the drill-string was found to have washed out. Approximately 1.25 hours were lost while the damaged pipe was located and removed.

### 1.12 Time Distribution

A full break-down of drilling operations can be found in Appendix 1a and a summary of time distribution is given in Appendix 1b. A drilling progress chart for the well is included as Figure 2.

## 1.13 Well Costs

A summary of costs for the drilling of Jamison 1 is given in Table 3.

TABLE 3  
JAMISON 1 WELL COSTS

ITEM	A \$
Site Preparation / Rehabilitation	39,999
Water	18,729
Mobilization	75,450
Camp	80,614
Drilling	401,790
Casing and Cement	26,335
Mudlogging	85,814
Wireline Logging/VSP	46,058
Drilling Mud and Services	26,530
DST Rental	57,173
Analysis	26,250
Communications / Office / Courier / Freight	35,987
Site Supervision/ Labour	52,851
Travel	27,183
Equipment Hire / Vehicle Costs / Misc.	3,116
Insurance	2,426
<b>TOTAL</b>	<b>1,006,302</b>

2. GEOLOGICAL DATA

## 2.1 Geological Summary

Jamison 1 was designed as a stratigraphic test to identify the type, nature and hydrocarbon prospectivity of the stratigraphy in the centre of a large gravity low, informally termed the Beetaloo Sub-basin. Gravity and magnetic modelling had suggested a thickening of the Proterozoic Roper Group of the McArthur Basin into a sub-basin east of the Stuart Highway between Larrimah and Elliott. Three previous wells (Altree 2, Walton 2, and McManus 1) drilled on the northern edge of the gravity low had confirmed this southward thickening. Jamison 1 was drilled near the centre of the gravity low and was sited on an apparent two-way closure on a field stack of the SH90-103 seismic line (Figure 1), almost 100km south of the nearest well control.

The well spudded in unconsolidated to poorly consolidated Cretaceous clay which was red down to 12 metres, then became white to yellowish orange with depth, and sandy over the lowermost eight metres down to the top of the Cambrian Tindall Limestone at 77 metres. The limestone was much